PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-329508

(43)Date of publication of application : 15.11.2002

(51)Int.Cl. H01M 8/02
H01M 4/86
H01M 4/88
H01M 8/12
H01M 8/24

(21)Application number : 2001-134695

(22)Date of filing : 01.05.2001

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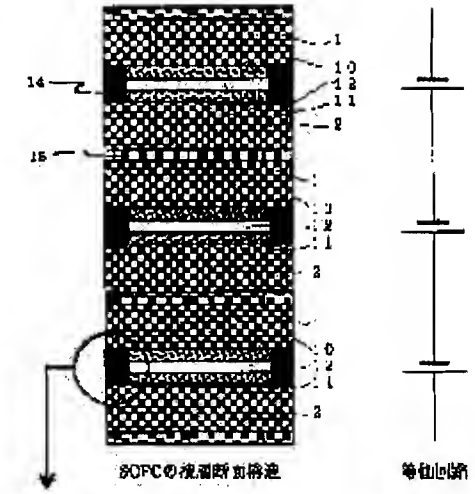
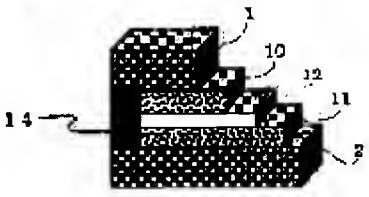
(54) SOLID ELECTROLYTE FUEL CELL AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solid electrolyte fuel cell and its manufacturing method providing miniaturization and reducing internal resistance by providing electrodes (an air electrode and a fuel electrode) and a solid electrolyte as thin films.

SOLUTION: In an SOFC, single cells comprised by holding electrode reaction parts 10-12 and 14 between porous metal substrates 1 and 2 and laminating an electrically conductive and gas impermeable substrate 13 are continuously connected, the electrode reaction parts are comprised by covering side faces of the air electrode 10, the solid electrolyte 12 and the fuel electrode 11 by an electrically insulating and gas impermeable substrate 14, the porous metal substrates 1 and 2 communicate gas, and a cell output is collected by the electrode reaction parts. The SOFC is comprised by continuously connecting single cells comprised by laminating the electrode reaction parts so that the porous metal substrates are held between the electrodes and laminating a porous metal substrate B. The SOFC is comprised by arranging a single cell component comprised by inscribing a porous metal substrate A in the electrode reaction parts in an insertion hole of the porous metal substrate B.





DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the solid oxide fuel cell (SOFC) which obtains electrical energy according to electrochemical reaction using a solid electrolyte, and, more particularly, relates to a solid oxide fuel cell which pinches a solid electrolyte by an electrode, and a manufacturing method for the same.
[0002]
[Description of the Prior Art]From the former, it has the composition which pinches a solid oxide electrolyte by two electrodes (anode), i.e., a fuel electrode, and an air pole (cathode) as a power generation element, The solid oxide fuel cell (it omits the following "SOFC") generated through oxidizing gases, such as oxygen and air, through hydrocarbon system fuel gas, such as hydrogen and methane, at the air pole side side to the fuel electrode side is known. The generation efficiency of this SOFC is high, and it is possible also for exhaust heat use, and is expected as a fuel cell of the third generation.
[0003]An electrolyte support type cell can be illustrated as the cellular structure of SOFC known from the former. This cell sinters electrolyte material powder with high density, uses it as a precise electrolyte object, and forms a fuel electrode and an air pole in that rear surface by screen-stencil etc. This cell is using the electrolyte as a support member of a power generation element. An electrode support type cell can be illustrated as other cellular structures. This cell sinters electrode material powder, uses it as a porous electrode object, and forms an electrolyte layer and an electrode layer by screen-stencil etc. on it. The porous electrode object is being used for this cell as a support member of a power generation element.
[0004]Specifically, the porous electrode base which comprises the sintered compact of the ceramics electrode material powder in which porosity differs in a board thickness direction is reported by JP,9-50812,A. The porous electrode base which comprises the sintered compact of ceramics electrode material powder similarly is reported by JP,2000-200614,A. The cell which produced the fuel electrode / electrolyte / air pole in the spraying process to the porous metal base is reported as a support member of a fuel electrode / electrolyte / air pole (it omits the following "power generation element"). The DLR cell (Plasma Sprayed Thin-FilmSOFC forReduced Operating Temperature, Fuel CellsBulletin, pp597-600-2000) is proposed again.
[0005]In order to collect the electric power generated in the fuel electrode and the air pole, by SOFC known from the former, charge collectors, such as nickel felt, are used separately from an electrode, as indicated by

JP,7-45297,A, JP,63-106063,U, etc. It is used for many battery elements by this SOFC, electrically connecting in series or in parallel.
In that case, the member (it omits the following "I. C. (interconnector)") which electrically connects each battery element is needed.
This I.C. may be provided with a charge collector function. SOFC needs again the member which forms the gas passageway for leading gas to an electrode surface in order to lead hydrocarbon system fuel gas, such as hydrogen and methane, to the fuel electrode side, to lead oxidizing gases, such as oxygen and air, to the air pole side side and to generate electricity. This gas passageway may be provided with an I.C. function.
[0006]
[Problem(s) to be Solved by the Invention]However, since an electrolyte was used for the above-mentioned electrolyte support type cell as a support member of a power generation element, electrolytic thickness might be about set to hundreds of micrometers - several millimeters from the mechanical intensity request, and the internal resistance of the electrolyte portion might increase it. Since an electrode was used for the above-mentioned electrode support type cell as a support member of a power generation element, the thickness of the electrode body might be about set to not less than several millimeters from the mechanical intensity request, and, in addition to the internal resistance of an electrode section increasing, the breathability and the diffusibility of fuel gas or a oxidizing gas might get worse. The porous-ceramics electrode substrate indicated by JP,9-50812,A and JP,2000-200614,A which have improved breathability has not enough and brittleness peculiar to a ceramics material to electrical conduction. I.C. and a gas passage member needed to be installed separately from the above-mentioned electrolyte support type cell or the above-mentioned electrode support type cell, and had become an obstacle of the miniaturization of SOFC again.
[0007]Probably for restrictions of ** thermal-spraying membrane formation in the cell obtained using the above-mentioned spraying process, Probably because each thickness of an electrode and an electrolyte is as thick as tens of micrometers and ** porosity metal body surface from which internal resistance is not subtracted is coarse, as a gas passageway to an electrode and ** cell lower fuel electrode from which-izing of the electrolyte cannot be carried out [thin film], and internal resistance is not subtracted, As a gas passageway to ** cell top air pole which cannot attain a cell miniaturization since a porous metal object is not used as a gas passageway but the plate which has a ****** section is used, Since a porous metal object was not used as a gas passageway but the plate 15 which has a ** wavelike section was used, there was what a cell miniaturization cannot be attained for.
[0008]this invention is made in view of the technical problem which such conventional technology has, and comes out. The purpose thin-film-izes an air pole, a fuel electrode, and a solid electrolyte, reduces internal resistance, and there is in providing a solid oxide fuel cell which attained the miniaturization, and a manufacturing method for the same.

[0009]
[Means for Solving the Problem]As a result of repeating examination wholeheartedly that an aforementioned problem should be solved, using a porous metal base which has desired intensity as a support base of a power generation element, by making a current collection function of a cell output, and a gas-passageway

function bear, this invention persons find out that an aforementioned problem is solvable, and came to complete this invention.

[0010]A solid oxide fuel cell of this invention namely, a single cell which laminates electrical conductivity and a gas impermeability base at the surface or a rear face of a sandwiching body which pinches both sides of an electrode reaction part by the porous metal bases A and B, It is a solid oxide fuel cell mostly connected with this laminating direction in a uniform direction, [two or more] The above-mentioned electrode reaction part is covered with electric insulation and a gas impermeability base, and changes the side of a layered product produced by laminating an air pole, a solid electrolyte, and a fuel electrode in this order, The above-mentioned porous metal bases A and B collect a cell output from the above-mentioned electrode reaction part, while circulating fuel gas or a oxidizing gas.

[0011]Other solid oxide fuel cells of this invention, An electrode reaction part is laminated to both sides of the porous metal base A so that the porous metal base A may be pinched with air poles or fuel electrodes, A single cell which laminates the porous metal base B to either of these electrode reaction parts, It is a solid oxide fuel cell mostly connected with this laminating direction in a uniform direction, [two or more] The above-mentioned electrode reaction part is covered with electric insulation and a gas impermeability base, and changes the side of a layered product produced by laminating an air pole, a solid electrolyte, and a fuel electrode in this order, The above-mentioned porous metal bases A and B collect a cell output from the above-mentioned electrode reaction part, while circulating fuel gas or a oxidizing gas.

[0012]A solid oxide fuel cell of further others of this invention, Two or more single cell composition parts inscribed in an annular electrode reaction part in the porous metal base A, It is a solid oxide fuel cell allocated in two or more insertion holes established in the porous metal base B, The above-mentioned electrode reaction part is covered with electric insulation and a gas impermeability base, and changes the side of a layered product produced by laminating an air pole, a solid electrolyte, and a fuel electrode in this order, The above-mentioned porous metal bases A and B collect a cell output from the above-mentioned electrode reaction part, while circulating fuel gas or a oxidizing gas.

[0013]Again a manufacturing method of a solid oxide fuel cell of this invention, In manufacturing the above-mentioned solid oxide fuel cell, an air pole or a fuel electrode is laminated on the (a) porous metal base A, (b) Laminate a solid electrolyte on this air pole or a fuel electrode, and laminate a fuel electrode or an air pole on (c) this solid electrolyte, (d) Laminate the porous metal base B on this fuel electrode or an air pole, and laminate electrical conductivity and a gas impermeability base on the (e) this porous metal base B, (f) Cover electric insulation and a gas impermeability base on the side of a layered product which this air pole and/or a fuel electrode, and the above-mentioned solid electrolyte make, make two or more single cell structures acquired by (g) laminating process (a) - (e) and a coating process (f) follow a laminating direction mostly in a uniform direction, and join.

[0014]Other manufacturing methods of a solid oxide fuel cell of this invention, In manufacturing the above-mentioned solid oxide fuel cell, an air pole or a fuel electrode is laminated to both sides of the (a) porous metal base A, (b) Laminate a solid electrolyte on this air pole or a fuel electrode, and cover electric insulation and a gas impermeability base on the side of a layered product which (c) this air pole or a fuel electrode, and a solid electrolyte make, (d) A single cell composition part which laminates a fuel electrode or an air pole to both sides

of the porous metal base B, covers electric insulation and a gas impermeability base on the side of (e) this fuel electrode or an air pole, and is obtained by the (f) laminating process (a), and (b) and a coating process (c), Two or more single cell composition parts obtained by laminating process (d) and a coating process (e) are made to follow a laminating direction mostly by turns in a uniform direction, and it joins.

[0015]A manufacturing method of further others of a solid oxide fuel cell of this invention, In manufacturing the above-mentioned solid oxide fuel cell, an air pole or a fuel electrode is covered on the side of a longitudinal direction of the (a) porous metal base A, (b) Cover a solid electrolyte on this air pole or a fuel electrode, and cover a fuel electrode or an air pole on (c) this solid electrolyte, (d) Establish two or more insertion holes in the porous metal base B, and allocate two or more single cell composition parts obtained by above-mentioned coating process (a) - (c) in (e) this insertion hole, (f) Cover electric insulation and a gas impermeability base to both ends of a longitudinal direction of this air pole, a fuel electrode, and a solid electrolyte, and join a wall, this fuel electrode, or an air pole of this insertion hole.

[0016]

[Embodiment of the Invention]Hereafter, the solid oxide fuel cell of this invention is explained in detail. In this specification,"%", unless it mentions specially, mass percentage is shown. It cannot be overemphasized that the composition of explanation which these are equivalent elements and was mutually replaced for convenience although the "surface" and the "upper surface", and other fields were indicated to be a "rear face", the "undersurface", etc. for one field, such as a base and an electrode, is also included in the range of this invention.

[0017]Like ****, the solid oxide fuel cell (it omits the following "SOFC") of this invention connects mostly with this laminating direction two or more single cells which laminate electrical conductivity and a gas impermeability base at the surface or the rear face of a sandwiching body which pinches both sides of an electrode reaction part by the porous metal bases A and B in a uniform direction. Typically, as shown in drawing 1, the tandem type SOFC which connects mostly two or more single cells (the composition of porous metal base 1 / air pole 10 / solid electrolyte 12 / fuel electrode 11 / porous metal base 2 is taken) used as a unit configuration element with this laminating direction in a uniform direction can be mentioned.

[0018]Here, the above-mentioned electrode reaction part covers with electric insulation and a gas impermeability base the side of the layered product produced by laminating the air pole 10, the solid electrolyte 12, and the fuel electrode 11 in this order so that it may illustrate to drawing 1. Thus, by covering the side of an electrode reaction part with an insulating member, the air pole 10, the fuel electrode 11, and the porous metal bases 1 and 2 are insulated certainly, and accumulation of a cell is made easy. As the above-mentioned electric insulation and gas impermeability base, glass, ceramics or the metal that covered the surface with glass or ceramics, the thing concerning these arbitrary combination, etc. can be used. It is preferred for this electric insulation and gas impermeability base to be covered with a thickness of 0.02-10 mm. Thickness also includes reliability in less than 0.02 mm, and it may stop being unable to secure sufficient insulation and being able to maintain it, and when it exceeds 10 mm, reliability falls by a crack, KAKE, etc. and it may stop the cell itself not only being enlarging, but being able to maintain insulation too.

[0019]Since electrical conductivity and a gas impermeability base are allocated between each battery element (an air pole, a solid electrolyte, and a fuel electrode), each battery element is connectable with a thickness

direction in series. As the above-mentioned electrical conductivity and gas impermeability base, a porous metal object, a metallic material of the same kind, etc. can be used. It is preferred for this electrical conductivity and gas impermeability base to use by a thickness of 0.05-10 mm. When thickness of intensity is low as a joining member between cells in less than 0.05 mm, and the good connection between cells may be checked and it exceeds 10 mm, the cell itself may thick-plate-ize and the reliability of a layered product may be spoiled on the contrary.

[0020]The above-mentioned porous metal bases A and B collect a cell output from the above-mentioned electrode reaction part, while circulating fuel gas or a oxidizing gas. By using the porous metal which has gas breathability and diffusibility as a support base, air can be supplied to this porous metal base 1 at the air pole 11 by which adhesion installation is carried out in fuel gas at this porous metal base 2 at the fuel electrode 10 by which adhesion installation is carried out. That is, since a porous metal base serves as a role of a support base, and a role of a gas passageway, it thin-film-izes all solid electrolytes, the air poles, and fuel electrodes, and can reduce internal resistance. The above-mentioned porous metal base is also bearing the role supporting a battery element, and even if it thin-film-izes a battery element, SOFC can hold desired intensity.

[0021]As for the above-mentioned porous metal bases A and B, it is desirable to have electrical conductivity, and they collect a cell output from the above-mentioned electrode reaction part in this case. That is, since the above-mentioned porous metal base serves also as a role of a collecting member, SOFC of this invention can be miniaturized. As this porous metal base, nickel (nickel), nickel chromium (nickel-Cr), Nickel chromium iron (nickel-Cr-Fe), nickel chromium tungsten molybdenum (nickel-Cr-W-Mo), Nickel cobalt (nickel-Co), nickel copper (nickel-Cu), silver (Ag), It is preferred to use the alloy containing silver palladium (Ag-Pr), silvery whiteness gold (Ag-Pt), iron chromium nickel (Fe-Cr-nickel) or iron chromium aluminum (Fe-Cr-aluminum), and the metal that comprises these arbitrary combination. Typically, although a porous metal base is used by the shape of foam which has a desired void content, it is not limited to in particular this, but can use the sintered compact of the metal fiber which has desired fine pores, the sintered compact of metal particles, a metallic mesh, etc. The porosity base which plated with metal (nickel, Ag, etc.) can also be used for ceramics. Tolerance sufficient in metallic materials other than the above for the reducing atmosphere or oxidizing atmosphere which fuel gas or a oxidizing gas makes may not be acquired. Although the book SOFC can use hydrocarbon system gas, such as methanol, natural gas, and gasoline, as fuel gas, the porous metal base installed in the fuel electrode side at this time needs to be made not to be committed by the sulfur etc. which are contained in fuel gas. Although the book SOFC can use oxygen gas and air as a oxidizing gas, it is necessary to make it the porous metal base installed in the air pole side at this time not oxidize in a oxidizing gas.

[0022]As for the above-mentioned porous metal bases A and B, it is preferred that it is a thickness of 0.1-5 mm. In this case, the intensity nature as a support member, the electrical conductivity as I.C. (interconnector), and the gas breathability and diffusibility as a gas passageway are securable. At less than 0.1 mm, intensity may be insufficient for the thickness of a porous metal base as a support member, or it may become insufficient [electrical conductivity], and when it exceeds 5 mm, the breathability of that a cell plate becomes thick and gas may get worse.

[0023]As the above-mentioned porous metal bases A and B, the layered product which laminates the

congener or the porosity base layer of a different kind from which a void content differs more than two-layer can be used. Since adhesion arrangement of the above-mentioned porous metal base can be carried out all over the fuel electrode which is a thin film battery element, or an air pole, a thin film battery element can be supported good, and it can perform good current collection. The component of congener or a porosity base layer of a different kind can be suitably chosen from the metallic material etc. which were mentioned above.
[0024]Thin film type SOFC which can collect a current to a thickness direction can be formed by using the above porous metal bases. The cell internal resistance of a thickness direction can be reduced from this. Specifically, the air pole which had the porous metal base covered and/or a fuel electrode, and the electrode which in other words the porous metal base touches among the above-mentioned air pole and a fuel electrode can be made into a thickness of 5-100 micrometers. in this case -- comparing with the conventional electrode support type cell -- thickness -- or less at least 1 / 20 -- reduction -- since things are made and the inner electrical resistance of an electrode section can be simply reduced about by 1/20, it is effective. The above-mentioned solid electrolyte can be made into a thickness of 50 micrometers or less. in this case -- comparing with the conventional electrolyte support type cell -- thickness -- or less at least 1 / 20 -- reduction -- since things are made and the inner electrical resistance of an electrolyte portion can be simply reduced about by 1/20, it is effective. This electrode and solid electrolyte can use for and cover various methods for film deposition, such as PVD, a CVD method, a spraying process, screen printing, a spray coating method, plating, an electrophoresis method, and a sol gel process. The green sheet containing an electrode and solid electrolyte materials can be stuck on this porous metal object, and an electrode and/or a solid electrolyte can be formed by sintering.
[0025]Next, other SOFC(s) of this invention are explained in detail. This SOFC connects mostly with this laminating direction two or more single cells which laminate an electrode reaction part to both sides of the porous metal base A so that the porous metal base A may be pinched with air poles or fuel electrodes, and laminate the porous metal base B to either of these electrode reaction parts further in a uniform direction. By having such SOFC composition, since what is necessary is just to lead fuel gas or a oxidizing gas to the porous metal base A and the porous metal base B, respectively and it becomes the miniaturization of a fuel cell, and simplification, it is effective. Typically, as shown in drawing 2, The parallel connected type SOFC which connects mostly two or more unit configuration elements (the composition of porous metal base 1 / fuel electrode 10 / solid electrolyte 12 / air pole 11 / porous metal base 2 / air pole 11 / solid electrolyte 12 / fuel electrode 10 is taken) with this laminating direction in a uniform direction can be mentioned.
[0026]Here, although the above-mentioned SOFC has the almost same composition as the tandem type SOFC mentioned above except having connected in parallel without electrical conductivity and a gas impermeability base, it is specifically different in respect of the following. That is, as the above-mentioned electric insulation and gas impermeability base, glass, ceramics or the metal that covered the surface with glass or ceramics, the thing concerning these arbitrary combination, etc. can be used. It is preferred for this electric insulation and gas impermeability base to be covered with a thickness of 0.02-10 mm. Thickness also includes reliability in less than 0.02 mm, and it may stop being unable to secure sufficient insulation and being able to maintain it, and when it exceeds 10 mm, reliability falls by a crack, KAKE, etc. and it may stop the cell itself not only being enlarging, but being able to maintain insulation too. As for the above-mentioned porous metal bases A and B, it

is preferred that it is a thickness of 0.1-5 mm. In this case, the intensity nature as a support member, the electrical conductivity as I.C. (interconnector), and the gas breathability and diffusibility as a gas passageway are securable. At less than 0.1 mm, intensity may be insufficient for the thickness of a porous metal base as a support member, or it may become insufficient [electrical conductivity], and when it exceeds 5 mm, the breathability of that a cell plate becomes thick and gas may get worse.

[0027]Next, SOFC of further others of this invention is explained in detail. This SOFC is allocated in two or more insertion holes which established two or more single cell composition parts inscribed in an annular electrode reaction part in the porous metal base A in the porous metal base B. By having such SOFC composition, since a gas seal's being easy (simple) and the becoming thermal shock resistance improve, it is effective. Typically, as shown in drawing 3, tube type SOFC which allocates two or more single cell composition parts (the composition which covered fuel electrode 10 / solid electrolyte 12 / air pole 11 in this order is taken on the periphery of the cylindrical porous metal base 1) in two or more insertion holes established in the porous metal base 2 can be mentioned. In this SOFC, it is connectable with series or parallel by arranging an insulating member suitably in the porous metal base 2. The shape of an insertion hole can illustrate a round shape, a square shape, an ellipse form, a triangle, etc.

[0028]Here, although the above-mentioned SOFC has the almost same composition as the tandem type SOFC and the parallel connected type SOFC which were mentioned above except having made the electrode reaction part annular, it is specifically different in respect of the following. That is, as for the above-mentioned porous metal bases A and B, it is preferred that it is a thickness of 0.1-5 mm. In this case, the intensity nature as a support member, the electrical conductivity as I.C. (interconnector), and the gas breathability and diffusibility as a gas passageway are securable. As for the intensity as a support member, less than 0.1 mm of the thickness of a porous metal base is not sometimes enough, and a cell and a stack may be enlarged when it exceeds 5 mm.

[0029]Next, the manufacturing method of SOFC of this invention is explained in detail. In this manufacturing method, an air pole or a fuel electrode is laminated on the (a) porous metal base A, (b) Laminate a solid electrolyte on this air pole or a fuel electrode, and laminate a fuel electrode or an air pole on (c) this solid electrolyte, (d) Laminate the porous metal base B on this fuel electrode or an air pole, and laminate electrical conductivity and a gas impermeability base on the (e) this porous metal base B, (f) Cover electric insulation and a gas impermeability base on the side of the layered product which this air pole and/or a fuel electrode, and the above-mentioned solid electrolyte make, (g) Laminating process (a) Make two or more single cell structures acquired by - (e) and a coating process (f) follow a laminating direction mostly in a uniform direction, and it joins, (h) Laminating process (d) - (e) and a coating process (f) are performed, for example under conditions (850 ** and 1 Pa), (i) joining process (g) is performed, for example under conditions (900 ** and 0.5 Pa), and the above-mentioned tandem type SOFC is obtained. By adopting this method, since thin-film-ized SOFC can manufacture an electrode (an air pole and a fuel electrode) and a solid electrolyte, it is effective. If it has desired SOFC composition, the above-mentioned process (a) - an order in particular of (i) are not limited, but, typically, can manufacture SOFC by a manufacturing process as shown in drawing 4. Since electric insulation and a gas impermeability base are eventually covered by the side of an electrode and a solid electrolyte, After covering electric insulation and a gas impermeability base as the above-mentioned coating

process (f) on the side of the above-mentioned air pole or a fuel electrode, and the above-mentioned solid electrolyte, a laminating process (c) can be performed so that electric insulation and a gas impermeability base may be covered by the side of a fuel electrode or an air pole. A base, an electrode, and a solid electrolyte are typically joinable by PVD, a CVD method, screen printing, a spray coating method, plating, an electrophoresis method, a sol gel process, etc. This electrode and solid electrolyte can use for and cover various methods for film deposition, such as PVD, a CVD method, a spraying process, screen printing, a spray coating method, plating, an electrophoresis method, and a sol gel process. The green sheet containing an electrode and solid electrolyte materials can be stuck on this porous metal object, and an electrode and/or a solid electrolyte can be formed by sintering.

[0030]Next, the manufacturing method of other SOFC(s) of this invention is explained in detail. In this manufacturing method, an air pole or a fuel electrode is laminated to both sides of the (a) porous metal base A, (b) Laminate a solid electrolyte on this air pole or a fuel electrode, and cover electric insulation and a gas impermeability base on the side of the layered product which (c) this air pole or a fuel electrode, and a solid electrolyte make, (d) The single cell composition part which laminates a fuel electrode or an air pole to both sides of the porous metal base B, covers electric insulation and a gas impermeability base on the side of (e) this fuel electrode or an air pole, and is obtained by the (f) laminating process (a), and (b) and a coating process (c), Make two or more single cell composition parts obtained by the laminating process (d) and a coating process (e) follow a laminating direction mostly by turns in a uniform direction, and it joins, (g) A laminating process (a), (b) and (d), and a coating process (c) are performed, for example under conditions (850 ** and 1 Pa), the (h) coating process (e) and a joining process (f) are performed, for example under conditions (900 ** and 0.5 Pa), and the above-mentioned parallel connected type SOFC is obtained. By adopting this method, since thin-film-ized SOFC can manufacture an electrode (an air pole and a fuel electrode) and a solid electrolyte, it is effective. If it has desired SOFC composition, an order in particular of above-mentioned process (a) - (h) is not limited, but, typically, can manufacture the parallel connected type SOFC by a manufacturing process as shown in drawing 5. A base, an electrode, and a solid electrolyte are typically joinable by PVD, a CVD method, screen printing, a spray coating method, plating, an electrophoresis method, a sol gel process, etc. This electrode and solid electrolyte can use for and cover various methods for film deposition, such as PVD, a CVD method, a spraying process, screen printing, a spray coating method, plating, an electrophoresis method, and a sol gel process. The green sheet containing an electrode and solid electrolyte materials can be stuck on this porous metal object, and an electrode and/or a solid electrolyte can be formed by sintering.

[0031]Next, the manufacturing method of SOFC of further others of this invention is explained in detail. An air pole or a fuel electrode is covered with this manufacturing method on the side of the longitudinal direction of the (a) porous metal base A, (b) Cover a solid electrolyte on this air pole or a fuel electrode, and cover a fuel electrode or an air pole on (c) this solid electrolyte, (d) Establish two or more insertion holes in the porous metal base B, and allocate two or more single cell composition parts obtained by above-mentioned coating process (a) - (c) in (e) this insertion hole, (f) Cover electric insulation and a gas impermeability base to the both ends of the longitudinal direction of this air pole, a fuel electrode, and a solid electrolyte, (g) Coating process (a) - (c) and (f) are performed, for example under 850 ** and the conditions of atmospheric pressure, the wall,

this fuel electrode, or air pole of this insertion hole is joined, and above-mentioned tube type SOFC is obtained. By adopting this method, since thin-film-ized SOFC can manufacture an electrode (an air pole and a fuel electrode) and a solid electrolyte, it is effective. If it has desired SOFC composition, an order in particular of above-mentioned process (a) - (g) is not limited, but, typically, can manufacture tube type SOFC by a manufacturing process as shown in drawing 6. A base, an electrode, and a solid electrolyte are typically joinable by PVD, a CVD method, screen printing, a spray coating method, plating, an electrophoresis method, a sol gel process, etc. The above-mentioned insertion hole can be formed with drilling, an electron discharge method, laser processing, etc., for example, and about 1-5-mm fine pores can turn into this insertion hole typically.

[0032]

[Example]Hereafter, although an example and a comparative example explain this invention still in detail, this invention is not limited to these examples.

[0033](Example 1) As shown in drawing 4, a metal particle sintered compact (firing metal of nickel-16Cr-8Fe) is used as the porosity base 1, The electrode 10 (nickel-8% YSZ) and the solid electrolyte 12 (8%YSZ) are laminated with screen printing to this at this order, Electric insulation and the gas impermeability base 14 are covered on the side of the electrode 10 and the solid electrolyte 12, The single cell which laminates the electrode 11 (LSC) with screen printing on the upper surface of the above-mentioned solid electrolyte 12, and laminates a metal particle sintered compact (firing metal of nickel-16Cr-8Fe) as the porosity base 2 on it, and also laminates electrical conductivity and the gas impermeability base 13, and serves as a SOFC constitutional unit was obtained. Two or more these single cells were laminated to the uniform direction, and the solid oxide fuel cell of the tandem type as shown in drawing 1 was obtained. It joined by heating and pressurizing at 900 ** and 0.5 Pa between each class. The composition of a porosity base, electric insulation and a gas impermeability base, electrical conductivity and a gas impermeability base, and a battery element (an electrode and a solid electrolyte) is shown in Table 1.

[0034](Example 2) The process shown in drawing 5 was adopted, except not using electrical conductivity and a gas impermeability base, the almost same operation as Example 1 was repeated, and the solid oxide fuel cell of the parallel connected type as shown in drawing 2 was obtained. The composition of a porosity base, electric insulation and a gas impermeability base, and a battery element (an electrode and a solid electrolyte) is shown in Table 1.

[0035](Example 3) The process shown in drawing 6 was adopted, not using electrical conductivity and a gas impermeability base, except having installed the cylindrical SOFC constitutional unit in the insertion hole of a porous metal base, the same operation as Example 1 was repeated, and the tube type solid oxide fuel cell as shown in drawing 3 was obtained. The composition of a porosity base, electric insulation and a gas impermeability base, and a battery element (an electrode and a solid electrolyte) is shown in Table 1.

[0036]

[Table 1]

実施例	多孔質基体A	電池要素			多孔質基体B	電気絶縁性・ガス不透過性体	電気伝導性・ガス不透過性体
		電極1	電解質	電極2			
実施例1	金属微粒子焼結体 厚み:2mm 空孔径:250um 気孔率:92% Ni-16Cr-8Fe	Ni-8%YSZ 厚み:30μm 印刷	8%YSZ 厚み:30μm 印刷	LSC 厚み:40μm 印刷	金属微粒子焼結体 厚み:2mm 空孔径:250μm 気孔率:92% Ni-16Cr-8Fe	ガラスペースト	金属シート 厚み:500μm Ni-16Cr-8Fe
実施例2	←	←	←	←	←	←	—
実施例3	←	←	←	←	←	←	—

[0037]As mentioned above, although the example explained this invention in detail, this invention is not limited to these and various modification is possible for it within the limits of the gist of this invention. For example, it is also possible to make into a constitutional unit the cell plate which the constitutional unit of SOFC is not limited to a single cell, but connects two or more single cells in the direction almost vertical to a laminating direction in two dimensions, and is unified. A gas passageway can also be installed inside a porous metal simple substance. The shape of SOFC can be chosen arbitrarily and can be produced according to the output of the purpose. A fuel electrode and the air pole can replace arrangement according to the circulating types of gas (hydrogen, air, etc.).

[0038]

[Effect of the Invention]As explained above, according to this invention, it writes using the porous metal base which has desired intensity as a support base of a power generation element with making the current collection

function of a cell output, and a gas-passageway function bear, An electrode (an air pole and a fuel electrode) and a solid electrolyte can be thin-film-ized, internal resistance can be reduced, and a solid oxide fuel cell which attained the miniaturization, and a manufacturing method for the same can be provided.

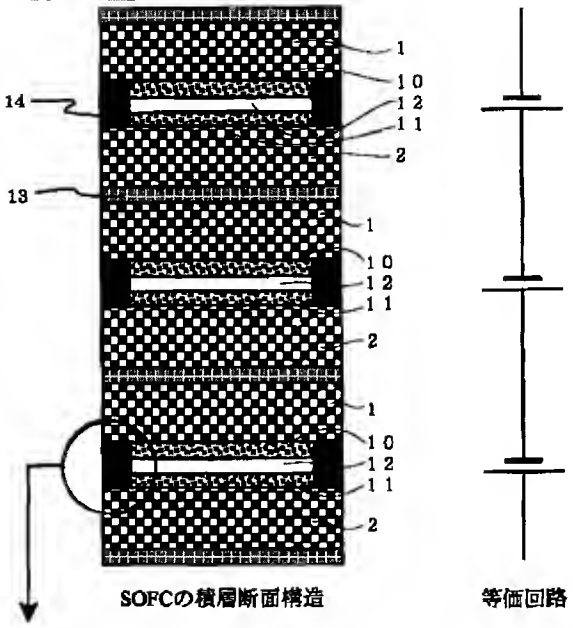
[Translation done.]

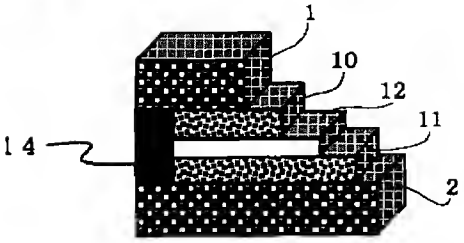
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

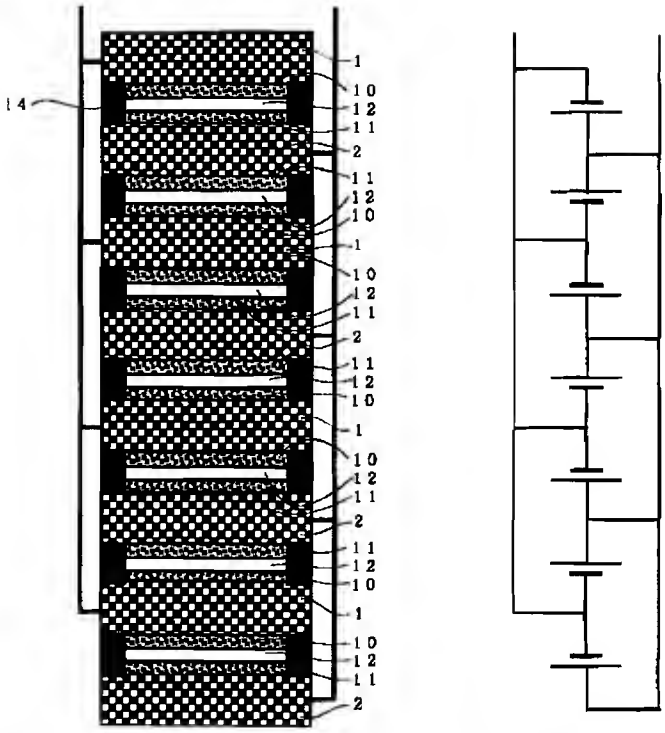
DRAWINGS

[Drawing 1]





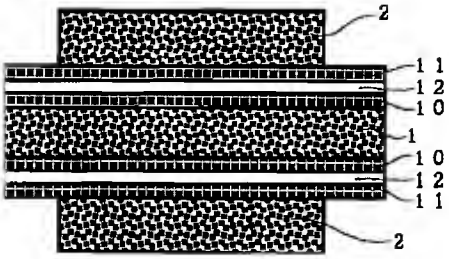
[Drawing 2]



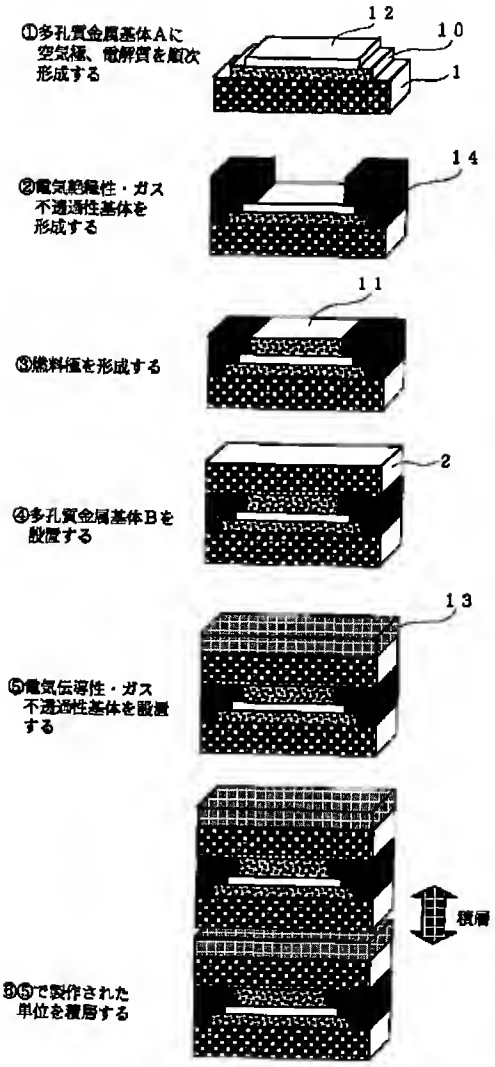
SOFCの積層断面構造

等価回路

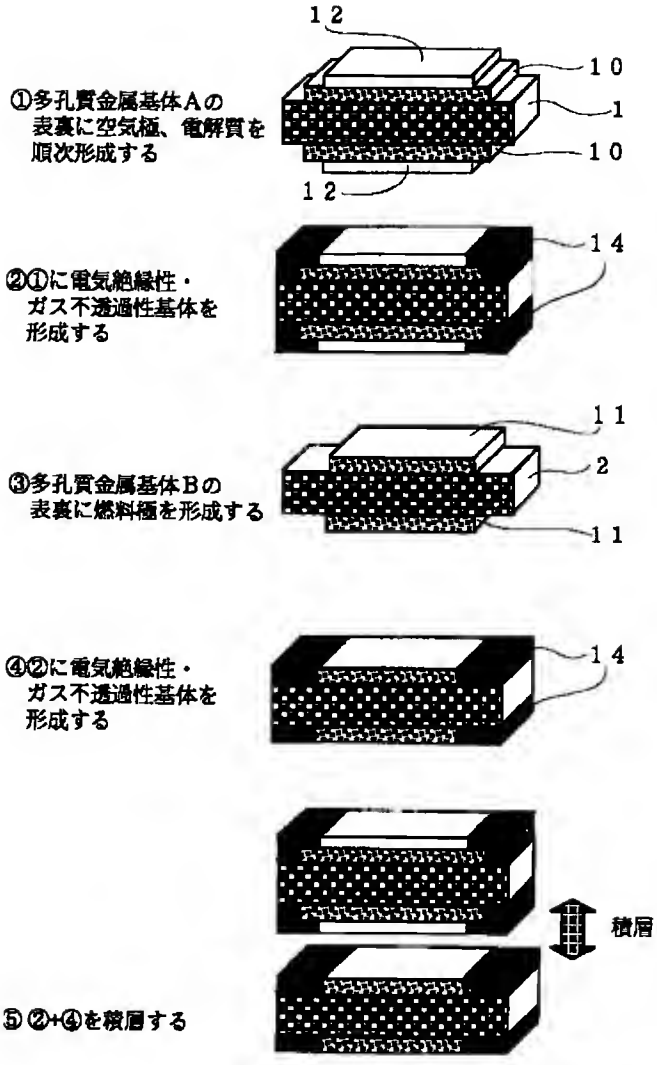
[Drawing 3]



[Drawing 4]

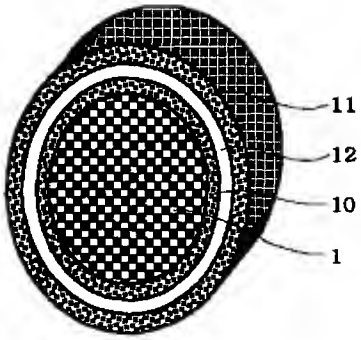

①多孔質金属基体Aに
空気極、電解質を順次
形成する
12
10
1
②電気絶縁性・ガス
不透過性基体を
形成する
14
③燃料極を形成する
11
④多孔質金属基体Bを
設置する
2
⑤電気伝導性・ガス
不透過性基体を設置
する
13
積層
③⑤で製作された
単位を積層する

[Drawing 5]

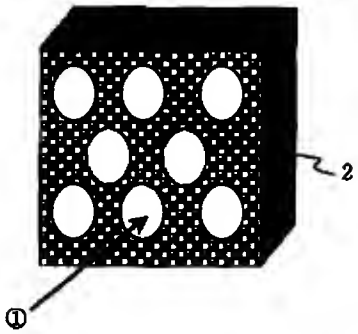

①多孔質金属基体Aの
表裏に空気極、電解質を
順次形成する
12
10
1
10
12
②①に電気絶縁性・
ガス不透過性基体を
形成する
14
③多孔質金属基体Bの
表裏に燃料極を形成する
11
2
11
④②に電気絶縁性・
ガス不透過性基体を
形成する
14
積層
⑤②+④を積層する

[Drawing 6]

①多孔質金属基体Aに
空気極、電解質、
燃料極を順次形成



②多孔質金属基体Bに
①を挿入設置



[Translation done.]